

# Lighting Compliance

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## Lighting Requirements

You can use COMcheck-EZ™ to demonstrate that your commercial or high-rise residential building design complies with energy codes based on *ASHRAE Energy Code for Commercial and High-Rise Residential Buildings* [ASHRAE 90.1 ('89) Code].

This guide covers the energy code requirements for lighting systems and equipment. It includes necessary tables, worksheets, and instructions for demonstrating compliance using an entirely manual method. All you need is a pencil and copies of the *Lighting Compliance Certificate* and *Lighting Application Worksheet* at the end of this guide.

The COMcheck-EZ software provides an alternative compliance method to using this guide. The compliance calculation used in the software is identical to the manual version in this guide. The software simply automates the calculation of the lighting power allowance for the building and the connected load of the lighting systems you specify. It also generates a compliance report to submit with your building permit application. Refer to the *COMcheck-EZ Software Compliance Guide* for instructions on obtaining and using the software.

## What the Energy Code Covers

To promote the use of energy-efficient lighting in commercial and high-rise residential buildings, the energy code requires

- manual or automatic controls or switches that allow occupants to dim lights and turn them on or off when appropriate. This guide identifies control, switching, and wiring requirements that apply to all buildings.
- total connected loads for indoor lighting systems that do not exceed power allowances for the building. This guide shows how to demonstrate compliance with interior-lighting power limits using the *Lighting Application Worksheet*.
- energy-efficient exterior lighting. This guide contains criteria for complying with exterior-lighting requirements.

## Demonstrating Compliance

To demonstrate compliance,

- indicate on your project plans switching schemes, fixture types, and lamp/ballast types that comply.
- complete the *Lighting Application Worksheet* included with this guide to indicate compliance with indoor-lighting power limits.
- complete the *Lighting Compliance Certificate* included with this guide. Use the actual fixture wattages or, if actual fixture wattages are unavailable, typical wattages from the *Typical Lighting Wattage* table at the end of this guide.

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## Control, Switching, and Wiring Requirements

All lighting systems must have controls or switches that allow occupants to manually or automatically dim lights or turn them on or off.

### Interior-Lighting Controls

Independent interior-lighting controls are required for each area enclosed by ceiling-height partitions. These controls can be any of the following:

- a switch located so the occupant can see the area controlled by the switch
- a switch that indicates whether the lights are on or off when it is impossible to see the controlled area from the switch location
- an occupant-sensing device.

Exceptions to this requirement are

- areas that must be continuously illuminated for building security or emergency exits. These areas must be designated as security or emergency exit areas on the plans, and the lights must be controlled by switches accessible only to authorized personnel.
- public areas, such as building lobbies and retail stores. These lights can be controlled by a single switch for the entire area.

### Master Switches in Hotel and Motel Guest Rooms

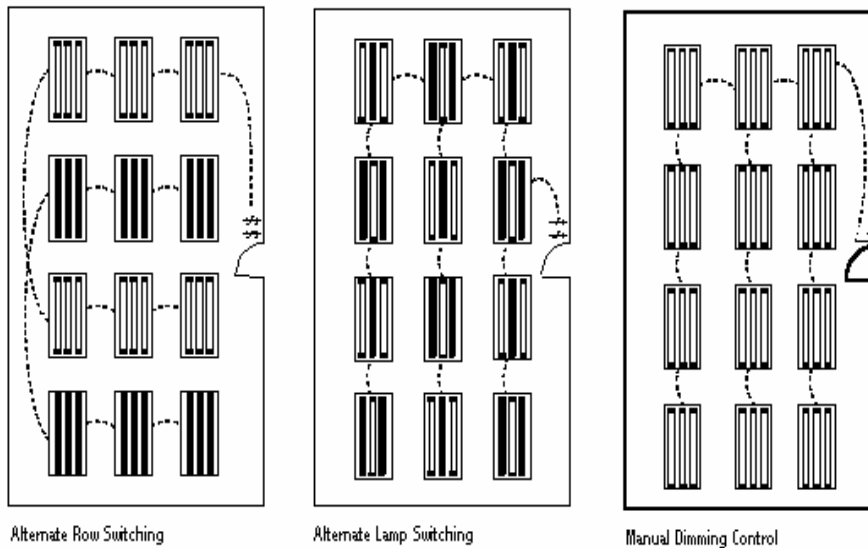
One or more master light switches are required at the entry door of hotel and motel guest rooms. Master switches operate all permanently wired luminaires and switched receptacles. These switches are usually three-way devices wired in combination with local controls. In multiple-room suites, a standard control device is required at the entrance to each separate room.

Bathroom lighting systems in hotel and motel guest rooms are exempt from these requirements.

## Bi-Level Switching

Lighting within a space must be switched so the occupant can reduce the connected lighting load by at least 50% in a reasonably uniform illumination pattern. Bi-level switching requirements may be met by

- switching alternate luminaires in a row or alternate rows of luminaires
- separately switching half of the lamps in each luminaire or two lamps in three-lamp luminaires
- using dimming controls on all lamps or luminaires.



Bi-level switching is not required if

- the area has only one luminaire
- an occupant-sensing device controls the area
- the area is a corridor, storage area, restroom, or lobby.

## Exterior Lighting Controls

Automatic controls are required for all exterior lights. The control may be a directional photocell, an astronomical time switch, or a building automation system with astronomical time switch capabilities. The control must automatically turn off exterior lighting when daylight is available. Lights in parking garages, tunnels, and other large-covered areas that must be on during daylight hours are exempt from this requirement.

## Tandem Wiring

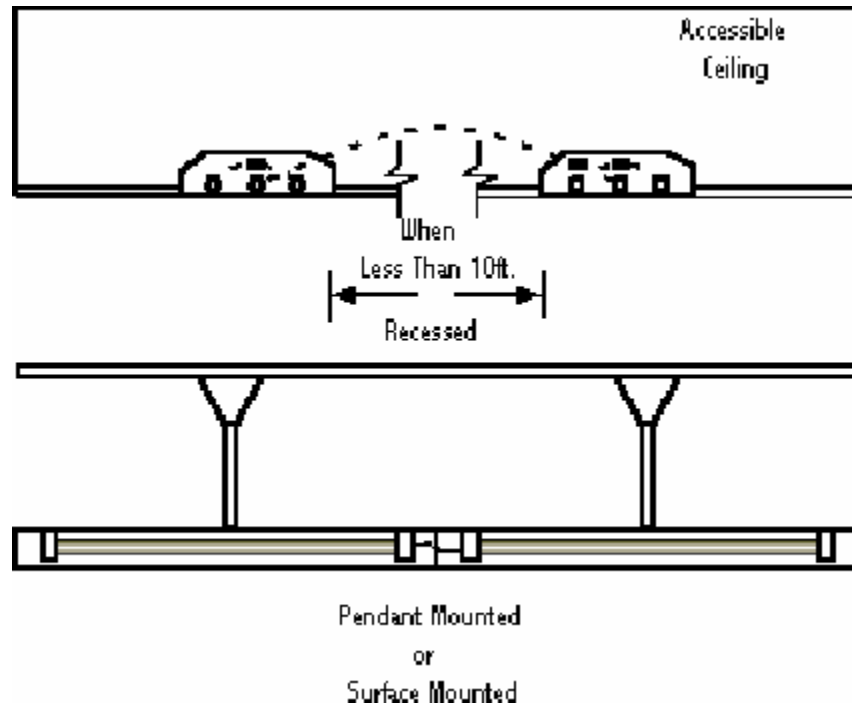
A two-lamp ballast is the most efficient conventional ballast type. The following types of one-lamp or three-lamp fluorescent fixtures must be tandem-wired:

- pendant- or surface-mounted luminaires in continuous rows

- recess-mounted luminaires located within 10 ft of each other and served by the same switch.

Exempted from this requirement are

- luminaires that use electronic high-frequency ballasts
- luminaires that are not on the same switch control or in the same area.



*Tandem Wiring*

## Interior Lighting Requirements

Interior lighting must not exceed allowed power limits. Interior lighting includes all permanently installed general and task lighting shown on the plans.

It does not include lighting used for theatrical, stage, or broadcasting productions; specialized lighting for medical, dental, and research purposes; display lighting for exhibits in galleries, museums, and monuments; lighting for indoor plant growth; emergency lighting that is normally off; lighting in high-risk security areas; lighting in areas designed primarily for the physically impaired or aged, or lighting in dwelling units.

To determine if your project complies with the interior-lighting power limits, follow the steps outlined below using the *Lighting Application Worksheet* included with this guide.

### Determining Allowed Watts for an Entire Building

First, if your project applies to the entire building, determine if an appropriate building type category is listed in Section 1, Column A on the Lighting Application Worksheet. Next, determine if Column B assigns a value for the entire building. If so, enter the square footage of the entire building in Column D. (If the value in Column B is N/A, follow the steps for tenant area or portion of building in the following section.) Multiply

the watts per sq ft in Column B by the square footage in Column D to determine the allowed watts. Enter the results in Column E.

This example shows how to calculate the total allowed watts for new general office space occupying an entire building totaling 10,000 sq ft. This building has a 1.7 watt per sq ft allowance. The total allowed watts value for the building is determined by multiplying Column B by Column D (17,000 watts).				
Section 1 – Allowed Lighting Power Calculation				
A	B	C	D	E
Building or Area Type	Entire Building (watts per sq ft)	Tenant Area or Portion of Building (watts per sq ft)	Building or Space (sq ft)	Allowed Watts** (B or C x D)
Office	1.7	1.8	10,000	17,000
Total Allowed Watts				17,000
**May use only Column B or Column C to qualify project. Do not use more than one column.				

*Example - Determining Allowed Watts for an Entire Building*

This example shows how to calculate the total allowed watts for new general office space occupying tenant area totaling 10,000 sq ft. The watts per sq ft allowance for this building is a combination of general office and corridor, restroom, and support areas. The total allowed watts value for the building is determined by multiplying the watts per sq ft for each area in Column C by the square footage of each area in Column D. The total allowed watts value is determined by adding the values in Column E (17,000 watts).				
Section 1 – Allowed Lighting Power Calculation				
A	B	C	D	E
Building or Area Type	Entire Building (watts per sq ft)	Tenant Area or Portion of Building (watts per sq ft)	Building or Space (sq ft)	Allowed Watts** (B or C x D)
Corridor, Restroom, Support Area	N/A	0.8	1,000	800
Office	1.7	1.8	9,000	16,200
Total Allowed Watts				17,000
**May use only Column B or Column C to qualify project. Do not use more than one column.				

*Example - Determining Allowed Watts for Tenant Area or Portion of Building*

## Determining Allowed Watts for Tenant Area or Portion of Building

If your project applies to only a portion of the entire building, is not listed as a building type, or has more than one occupancy type, circle the appropriate value for each type in Section 1, Column C on the *Lighting Application Worksheet*. Next, determine the total area of each type and enter the square footage for each in Column D. Multiply the watts per sq ft in Column C by the square footage in Column D. Enter the results in Column E. Sum the values in Column E to determine the total allowed watts.

## Determining Total Actual Watts and Compliance

Next, complete Section 2 on the *Lighting Application Worksheet* to determine the total actual watts. For each fixture type in your project, list the fixture type, fixture description, quantity, and watts per fixture, including ballasts.

- For screw lamp holders, use the maximum labeled wattage of the luminaire.
- For low-voltage lighting, use the specified wattage of the transformer supplying the system.
- For all other lighting equipment, use data furnished by the manufacturer.
- For line-voltage track lighting systems, use the larger of the results from the three bullets above or 30 watts per linear foot of track.

If actual input wattages are not known, you may use values from the *Typical Lighting Wattage* tables at the end of this section; however, actual fixtures used in the building must meet or exceed the efficiency of the fixtures assumed in the compliance analysis.

Multiply the value in Column D by the value in Column E to calculate the total watts for each fixture type. Enter the results in Column F. Sum the values in Column F to determine the total actual watts. If you need to list more equipment, use additional worksheets as continuation sheets.

Finally, determine if your project complies by completing Section 3 on the *Lighting Application Worksheet*. First, enter the total allowed watts on line 1. If you used additional worksheets as continuation sheets, don't forget to include values from each additional sheet in this total. Next, enter the total actual watts on line 2. Subtract line 1 from line 2 to determine compliance. The project complies if line 3 is zero or greater.

This example shows how to complete Sections 2 and 3 of the <i>Lighting Application Worksheet</i> . The interior of this example building is lit with two high-efficiency lighting groups—recessed PL downlights and a 2x4 fixture with electronic ballasts and T-8 lamps. This system also includes standard incandescent lamps. Adding the values in Column F shows that this project will have 16,660 total actual watts of installed interior lighting.					
Section 2 – Actual Lighting Power Calculation					
A	B	C	D	E	F
Fixture ID	Fixture Description	Lamp/Ballast	Quantity	Watts per Fixture	D x E
F1	2x4 Recessed Troffer	T8/Electronic	110	121	13,310
F2	Recessed CFL Fixture	CFL 18	50	22	1,100
F3	Medium-Base Socket	100 W	30	75	2,250
Total Actual Watts					16,660
The value resulting from subtracting the total actual watts from the total allowed watts indicates if the project complies. Our example project complies by 340 watts and, if properly switched, controlled, and wired, complies with the lighting requirements.					
Section 3 – Compliance Calculation					
1	Total Allowed Watts				17,000
2	Total Actual Watts				16,660
3	Project Compliance (line 1 – line 2; must be zero or greater)				340

*Example - Determining Total Actual Watts and Lighting Compliance*

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## Exterior Lighting Requirements

Exterior lighting must meet the following criteria to comply:

- All lighting supplied through the building electrical service must comply.
- Energy-efficient lighting must be used when illuminating paths, walkways, and parking areas. Complying types of energy-efficient lighting sources include fluorescent lamps and ballasts, compact fluorescents, metal halide lamps and ballasts, and high-pressure sodium lamps and ballasts.
- Any lighting that has an efficacy of 45 lumens per watt or greater is allowed for exterior lighting.

These requirements do not apply to

- specialized signal, directional, and marker lighting associated with air, rail, water, and road transportation
- lighting used to highlight features of registered historic landmark structures or buildings
- lighting integral to advertising signage
- lighting used for safety or security specifically designed to meet health or life safety requirements
- low-voltage lighting used exclusively for landscaping.

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## Completing Lighting Compliance Certificate

These instructions explain the information to include in the *COMcheck-EZ* Lighting Compliance Certificate, identify the appropriate contact or reference if you have questions, provide *EZ* tips for completing the certificate, and provide instructions for completing the Lighting Power Calculation. A sample certificate and worksheet are also provided. The instructions have numbered circles that correspond to those on the sample certificate and worksheet. For code enforcement officials, *EZ* tips for plan check and field inspection are included at the end of this guide.

### General Guidance

**For Documentation Authors:** Provide all information in unshaded sections, entering "N/A" if a particular requirement is not applicable; submit the completed certificate to the authority having jurisdiction with the building permit application package.

**For Plan Checkers:** Verify that proposed values listed on the certificate are consistent with the plans and specifications and with the requirements in this guide.

**For Field Inspectors:** Inspect and approve building construction against each requirement in Section 3 of the certificate.